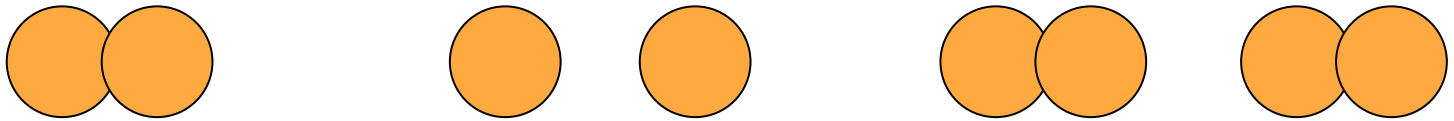
BALANCING EQUATIONS & TYPES OF CHEMICAL REACTIONS

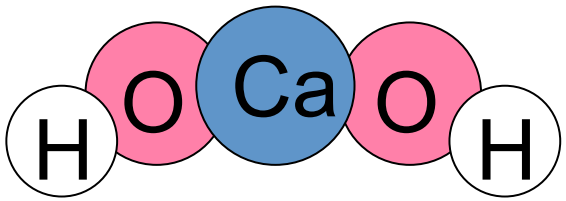
physical science

How molecules are symbolized

Cl_2 2Cl $2Cl_2$



- Molecules may also have parenthesis to indicate numbers of atoms. E.g. $Ca(OH)_2$
- Notice that the OH is a group
- The 2 refers to both H and O



- How many of each atom are in the following?

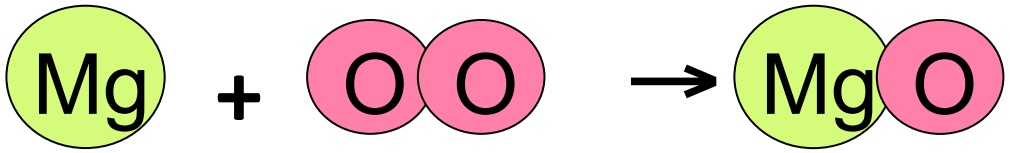
a) NaOH Na = 1, O = 1, H = 1

b) $Ca(OH)_2$ Ca = 1, O = 2, H = 2

c) $3Ca(OH)_2$ Ca = 3, O = 6, H = 6

Balancing equations: MgO

- The law of conservation of mass states that matter can neither be created or destroyed
- Thus, atoms are neither created or destroyed, only rearranged in a chemical reaction
- The number of a particular atom is the same on both sides of a chemical equation
- Example: Magnesium + Oxygen
- $Mg + O_2 \rightarrow MgO$



- However, this is not balanced
- Left: Mg = 1, O = 2
- Right: Mg = 1, O = 1

If the number of atoms is not the same on both sides we must BALANCE the equation

$Mg + O_2 \rightarrow MgO$

$2Mg + O_2 \rightarrow 2MgO$ is correct

- Left: Mg = 2 O = 2
- Right: Mg = 2 O = 2

$Mg + \frac{1}{2}O_2 \rightarrow MgO$ is incorrect

$4Mg + 2O_2 \rightarrow 4MgO$ is incorrect

Hint: Start with elements that occur in one compound on each side.

The matter on the left side of the reaction is called the REACTANTS the right hand side of the equation is called the PRODUCTS

Balance these skeleton equations:

a) $Mg + HCl \rightarrow MgCl_2 + H_2$

b) $Ca + N_2 \rightarrow Ca_3N_2$

c) $NH_4NO_3 \rightarrow N_2O + H_2O$

d) $BiCl_3 + H_2S \rightarrow Bi_2S_3 + HCl$

e) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

f) $O_2 + C_6H_{12}O_6 \rightarrow CO_2 + H_2O$

g) $NO_2 + H_2O \rightarrow HNO_3 + NO$

h) $Cr_2(SO_4)_3 + NaOH \rightarrow Cr(OH)_3 + Na_2SO_4$

i) $Al_4C_3 + H_2O \rightarrow CH_4 + Al(OH)_3$

HOW'D YOU DO??

a) $Mg + \mathbf{2}HCl \rightarrow MgCl_2 + H_2$

b) $\mathbf{3}Ca + N_2 \rightarrow Ca_3N_2$

c) $NH_4NO_3 \rightarrow N_2O + \mathbf{2}H_2O$

d) $\mathbf{2}BiCl_3 + \mathbf{3}H_2S \rightarrow Bi_2S_3 + \mathbf{6}HCl$

e) $\mathbf{2}C_4H_{10} + \mathbf{13}O_2 \rightarrow \mathbf{8}CO_2 + \mathbf{10}H_2O$

f) $\mathbf{6}O_2 + C_6H_{12}O_6 \rightarrow \mathbf{6}CO_2 + \mathbf{6}H_2O$

g) $\mathbf{3}NO_2 + H_2O \rightarrow \mathbf{2}HNO_3 + NO$

h) $Cr_2(SO_4)_3 + \mathbf{6}NaOH \rightarrow \mathbf{2}Cr(OH)_3 + \mathbf{3}Na_2SO_4$

i) $Al_4C_3 + \mathbf{12}H_2O \rightarrow \mathbf{3}CH_4 + \mathbf{4}Al(OH)_3$

BALANCING EQUATIONS PRACTICE!

$$\_\,N_2 + \_\,H_2 = \_\,NH_3$$

Reactants
N =
H =

Products
N =
H =

$$\_\,Al + \_\,HCl = \_\,AlCl_3 + \_\,H_2$$

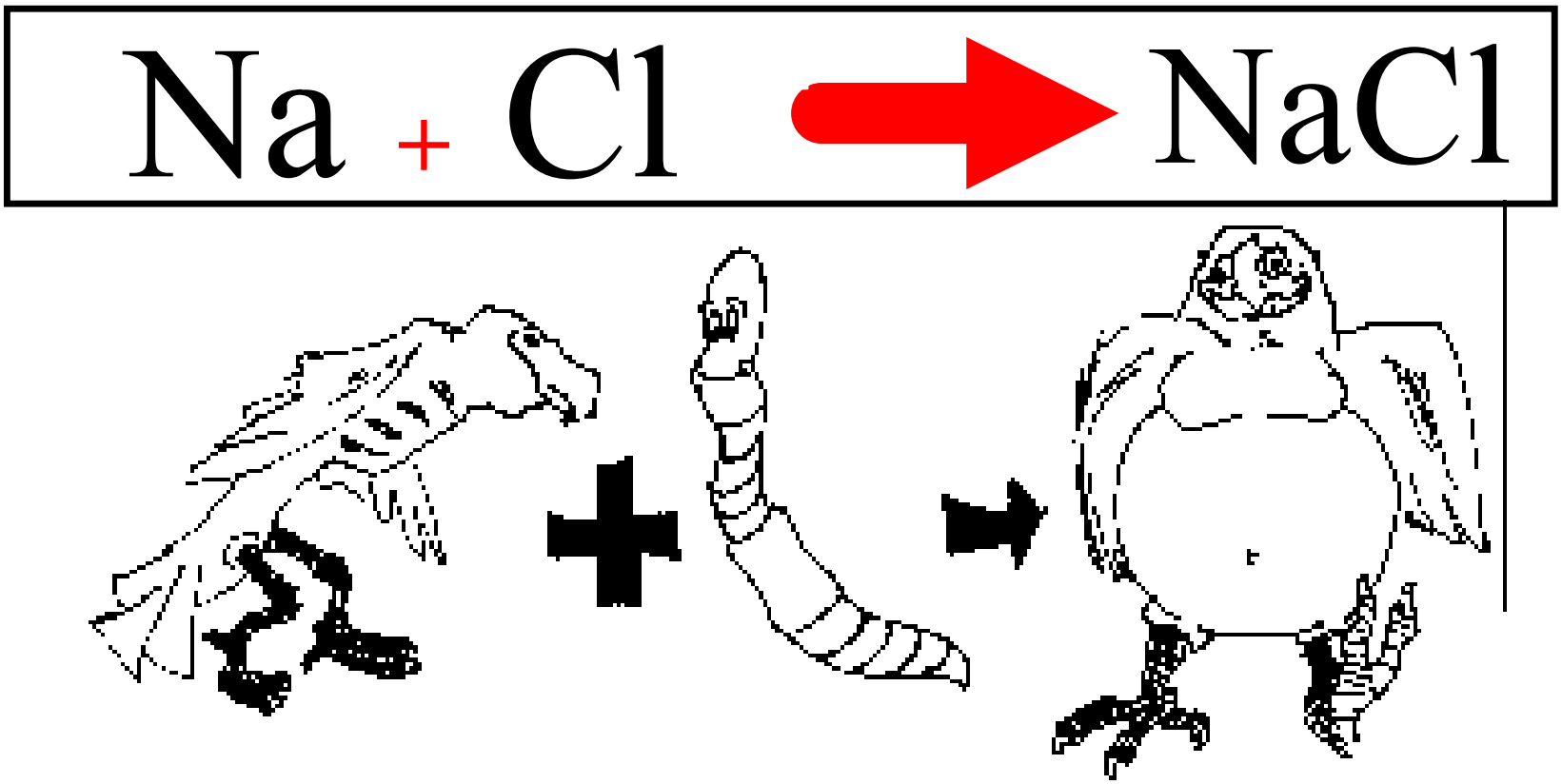
Reactants
Al =
H =
Cl =

Products
Al =
H =
Cl =

- $Li + H_2O \rightarrow H_2 + LiOH$
- $Bi(NO_3)_3 + K_2S \rightarrow Bi_2S_3 + KNO_3$
- $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

TYPES OF CHEMICAL REACTIONS

a. Direct Combination / Synthesis Reaction

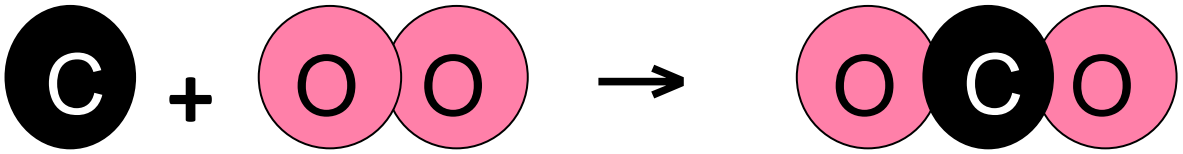


A synthesis reaction is when two or more simple compounds combine to form a more complicated one. These reactions come in the general form of:

A + B ---> AB

Types: Synthesis

Example C + O_2



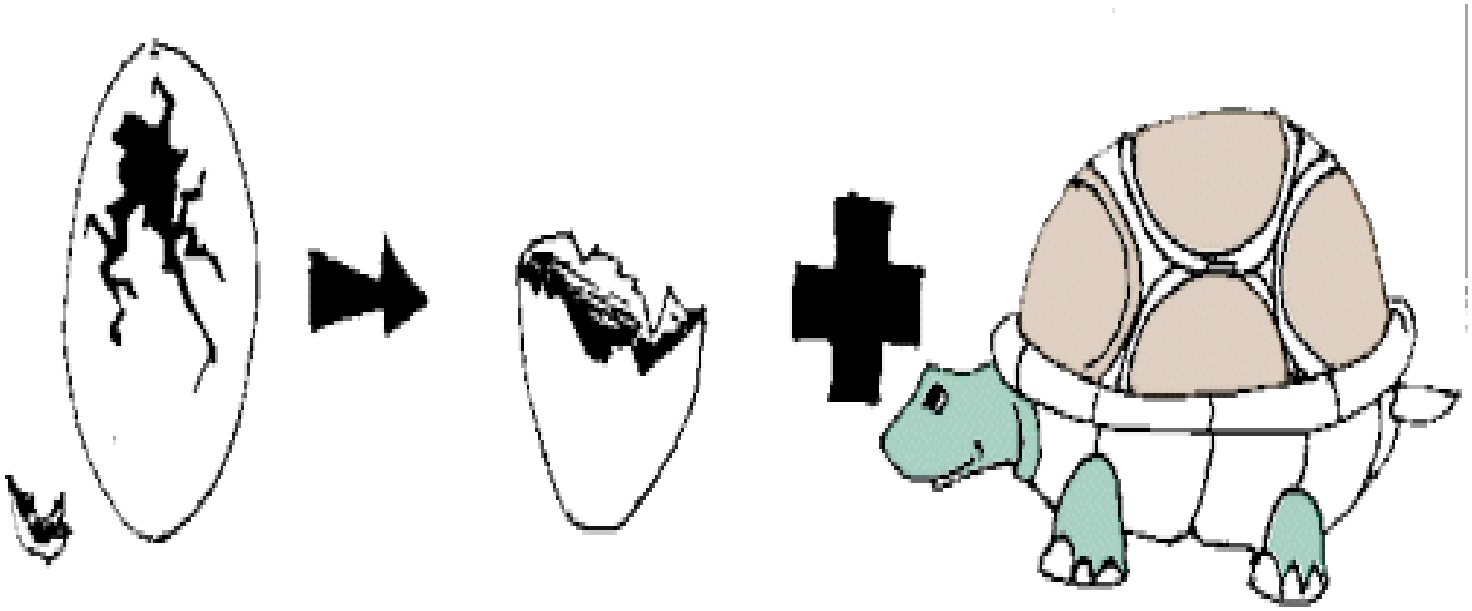
$$C + O_2 \rightarrow CO_2$$

Iron + Sulfur => Iron (II) sulfide

Example… H2+2O2 => 2H2O
-- The challenger --

b. Decomposition Reaction

$$Li_2O \rightarrow Li + O$$

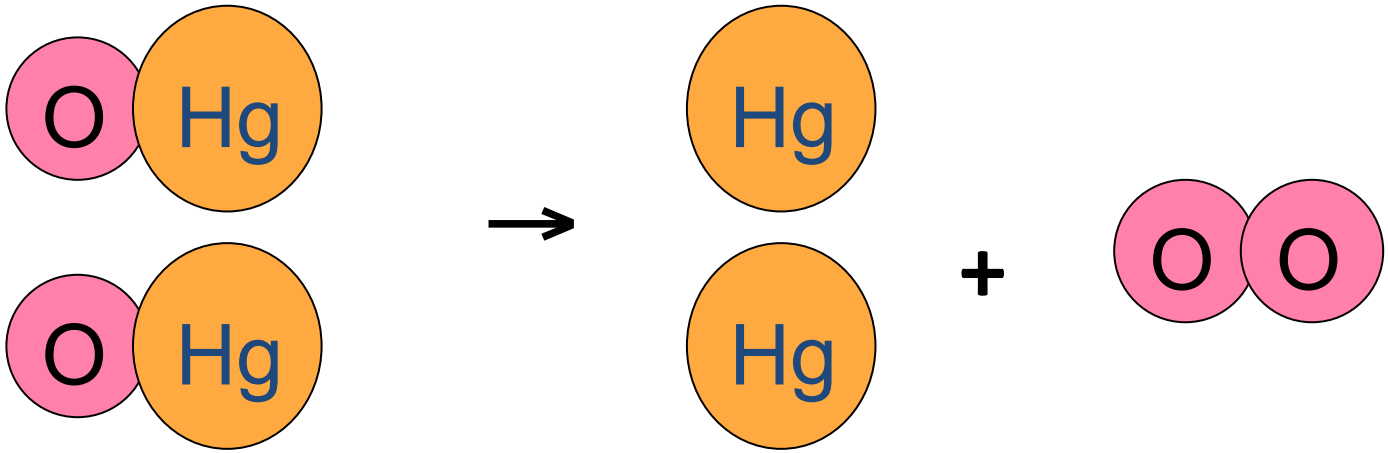


A decomposition reaction is the opposite of a synthesis reaction - a complex molecule breaks down to make simpler ones. These reactions come in the general form:

AB ---> A + B

Types: Decomposition

Example 2HgO

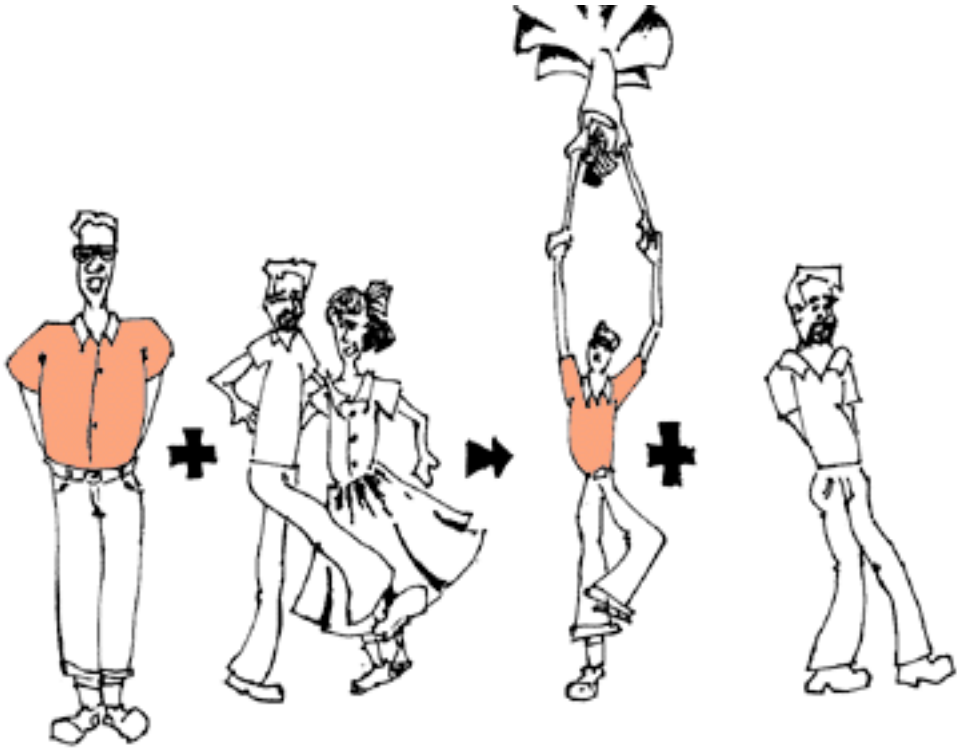


$$2HgO \longrightarrow 2Hg + O_2$$

Hydrogen peroxide = (catalyst magnesium oxide) => oxygen and water

c. Single Replacement Reaction

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$

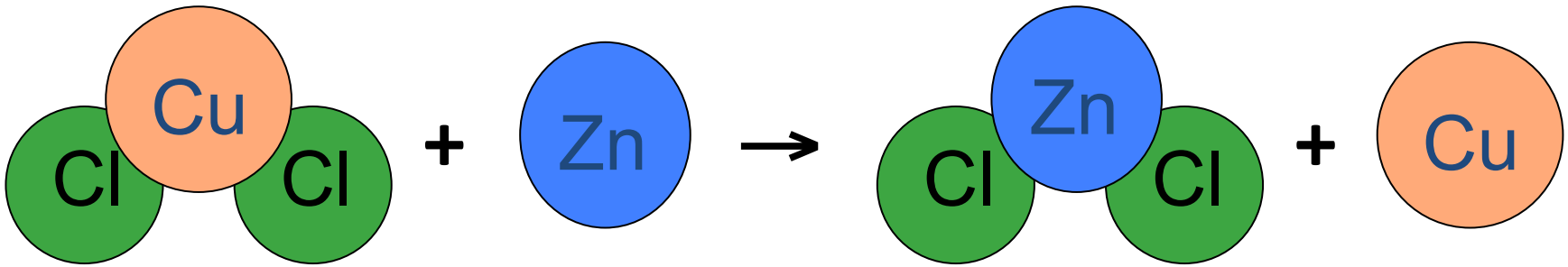


This is when one element trades places with another element in a compound. These reactions come in the general form of:

A + BC ---> AC + B

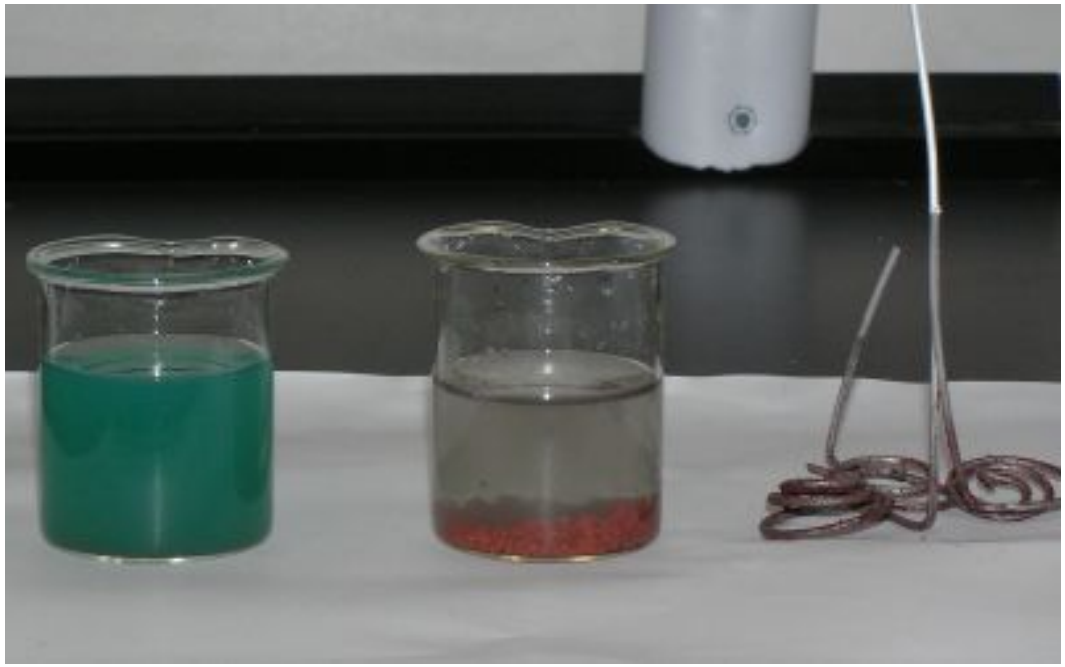
Types: Single replacement

Example: $Zn + CuCl_2$



$Zn + CuCl_2 \longrightarrow ZnCl_2 + Cu$

Remember our lab activity with aluminum foil and copper (II) chloride??

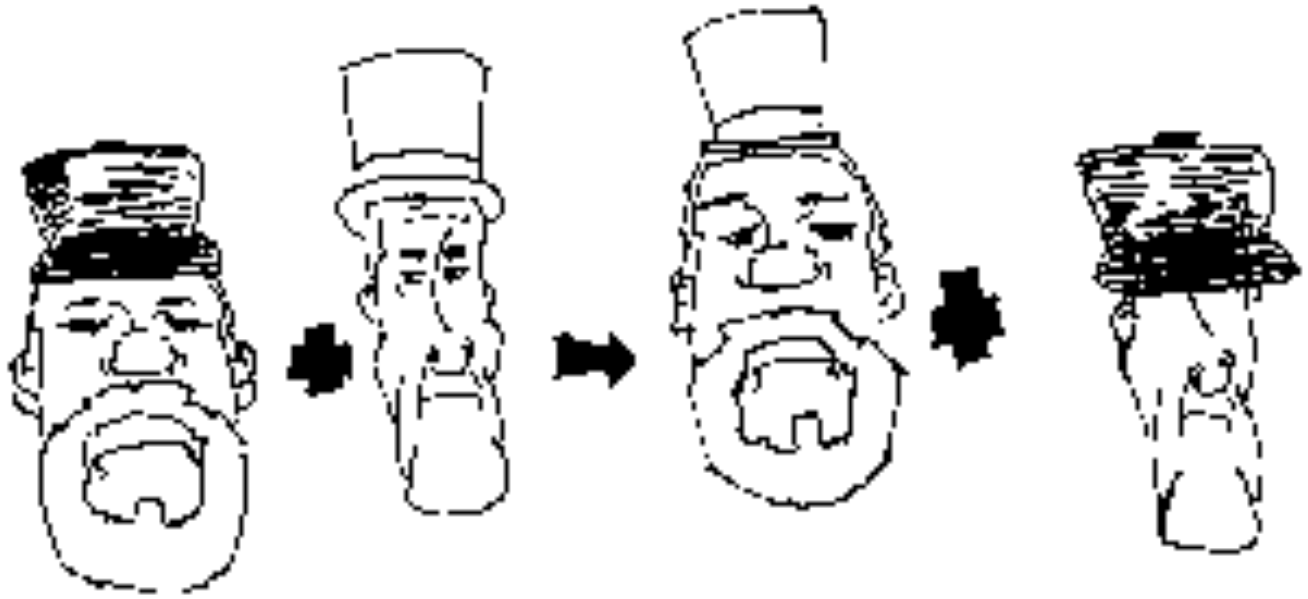


That was a single replacement reaction!! The aluminum replaced the copper

$Al + 3CuCl_2 \longrightarrow 2 AlCl_3 + 3 Cu$

d. Double Replacement Reaction

$$NaCl + MgS \rightarrow Na_2S + MgCl_2$$

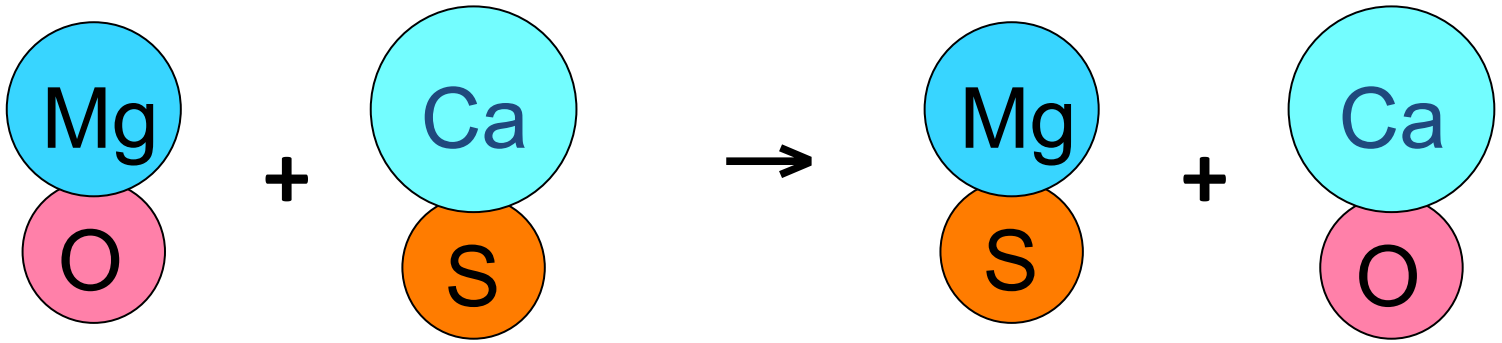


This is when the anions and cations of two different molecules switch places, forming two entirely different compounds. These reactions are in the general form:

AB + CD ---> AD + CB

Types: Double replacement

Example: MgO + CaS



$$MgO + CaS \longrightarrow MgS + CaO$$

Example – double replacement reaction!!!

$$2KI(aq) + Pb(NO3)2(aq) \rightarrow 2KNO3(aq) + PbI(s)$$

Notice the color change! And the formation of a precipitate!! Those are both indicators that a chemical reaction has taken place!

What type of reaction?

____ NaBr + ____ H_3PO_4 → ____ Na_3PO_4 + ____ HBr

Type of reaction: _____

____ $Ca(OH)_2$ + ____ $Al_2(SO_4)_3$ → ____ $CaSO_4$ + ____ $Al(OH)_3$

Type of reaction: _____

____ Mg + ____ Fe_2O_3 → ____ Fe + ____ MgO

Type of reaction: _____

What type of reaction?

____ $PbSO_4$ → ____ $PbSO_3$ + ____ O_2

Type of reaction: _____

____ NH_3 + ____ I_2 → ____ N_2I_6 + ____ H_2

Type of reaction: _____

____ H_2O + ____ SO_3 → ____ H_2SO_4

Type of reaction: _____